

Yin-Yang theory and Meridian-collateral system in urban planning: A case study of Cerdá's Eixample Plan in Barcelona

Xiang Yue, Wang Jing, Lu Wenhua

Department of Architecture, College of Civil Engineering and Architecture, Zhejiang University,
Hangzhou, China

Director: Prof. Hou Deqian

Mail: xiangyue27@hotmail.com

389190731@qq.com

lwh0314@126.com

ABSTRACT

Yin-Yang theory is the theoretical basis for Chinese medicine. In the view of Yin-Yang theory, city can be regarded as an organism and the Meridian-collateral system of urban planning constitutes the decisive factor for its quality and equality. To explore Cerda's wisdom beyond history, we made an analogy between city with the Life body, and proposed the concept of urban Organism. We analyzed the Eixample plan for Barcelona made by Cerdá from the three concepts : Yin-Yang, Meridian-collateral system and acupuncture points. This paper researches the wisdom why the plan set by Cerdá more than 150 years ago still perfectly suits to the life of a contemporary city, and tries to explore the mechanism and method of designing a balanced city.

Key words: Yin and Yang, Meridian-collateral system, acupuncture point, Eixample plan

1. INTRODUCTION

150 years ago, Cerdà¹ made his visionary grid planning for Barcelona. Under the guidance of Cerdà's Eixample plan², Barcelona has maintained vigorous growth and become one of the most habitable cities in the world.

"Yi" treats the world we live in as a non-stop cycle System, to explain the formation and development of the universe. According to Yi, everything has its positive and negative aspects, namely the attribute of yin-yang³, whose applications were immeasurable. It is also a kind of simple dialectical view of equilibrium values, which influences generations of Chinese thought.

To explore Cerdà's wisdom beyond history, we made an analogy between city, which is also a complex system, with the Life body, and proposed the concept of urban Organism. We analyzed the Eixample plan for Barcelona made by Cerdà from the three concepts: Yin-Yang, Meridian-collateral system and acupuncture points. We have drawn a conclusion that the success of Cerdà's plan in the past 150 years is due to its core value-building a balanced city, which is in accordance with the doctrine of balance between Yin and Yang.

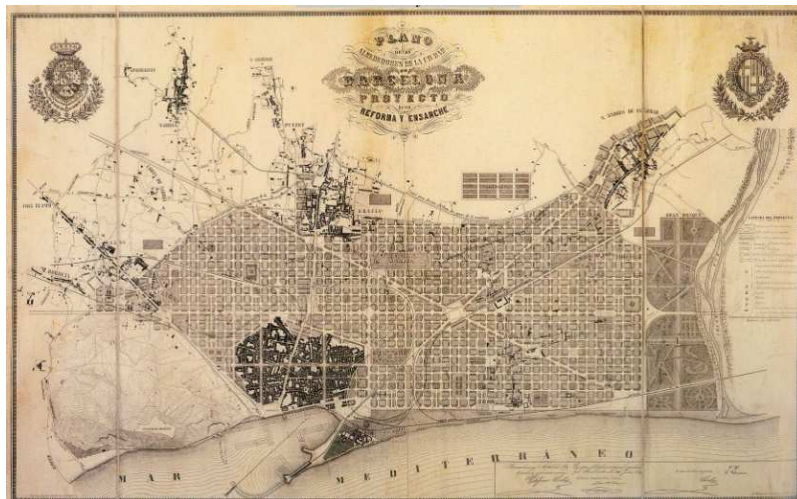


Fig1 Cerdà's 1859 map for the Eixample

(Source: Cerdà, 1859)

¹ Cerdà, 1815-1876, studied at the recently opened School for Civil Engineering in Madrid (graduated, 1841). As a civil engineer he took up various posts. Eventually in 1848 he settled in Barcelona. The untimely death of his brothers made him heir (hereu) to the family property. He became, then, a great landowner. It was a very important circumstance in his life: in that moment, he left his official work as civil engineer and could dedicate at full time to the urban planning studies and its projection to Barcelona.

² Barcelona extension, locally known as "Eixample", is the name that identifies today the heart of Barcelona: the "new town" projected by Cerdà in 1859 and constructed just around the walls of the old city (walls demolished in 1854).

³ Yin-yang, deriving the principle of duality which was developed into a huge academy of polarized natures. Such as distinguishing the sky from the ground, up and down, front and back. Other explanation depicts yin and yang as originated from the ideas of darkness and brightness, which convey the literal meaning of the words. However with extended analogy such representation could easily be applied to all polarities in nature, thus explain its extensive application in philosophy.

2. URBAN ORGANISM

City is a product of a certain historical stage reflecting the development of social productivity. It is the emergence of the social and economic development, together with technology progress, which is an important sign of human civilization. Urban organism is defined by land, building, traffic, population, energy, resources and other components, which can use similar organisms autotrophic or heterotrophic for energy conversion, material recycling and waste excretion. City has natural growth, energy release and waste production just as life does.

Urban Organism is a complex physical system. It obtains some materials from the external environment, which mainly includes a variety of household items as well as raw materials for production, and also outputs some metabolites to the environment, which mainly refers to exhaustwaste water and solid waste. The collection and disposal system of these products, such as water supply and drainage systems, waste disposal systems, etc, constitute the metabolic system of urban Organism.

To take the city as a living body, establishing a comprehensive knowledge of the dynamics of the city is more important than the metaphor itself. Even though analyzing city problems from the perspectives of economics, geography, political science, sociology or architecture can lead to clear-cut "cross-sectional views", these investigations may not necessarily truly understand the complex city issues. Like the human body, city is also a complex and unified totality. Apart from this similarity, city and human body are also analogous in terms of their high consistency in composition and classification. For example, the lifeblood of the city, is the flow of the people, logistics, traffic, financial flow, information flow, only the smoothness of which can make the city prosper; City metabolic cycle includes water, electricity, heat and other energy consumption; and the soul of the city is each city's cultural value and unique character of each city.

Thus, we will build the model of the urban organism to analyze Cerdà's Barcelona Example plan⁴ from three concepts inspired by traditional Chinese medicine (TCM⁵). There are Yin-Yang, Meridians and acupuncture points.

⁴ Between 1857 and 1860 three urban-planning projects to enlarge Barcelona were presented by Ildefons Cerdà i Sunyer in 1860, Miquel Garriga Roca between 1857 and 1858, and Antoni Rovira i Trias in 1859. The proposal presented by Rovira i Trias was chosen by the Barcelona City Government, whereas the proposal presented by Cerdà i Sunyer was chosen by the government of Madrid and signed by Queen Isabel II in 1860. Much controversy and opposition surrounded the approval and development of Cerdà's proposal. Political and social claims comprising low sustainable argumentation contradicted the plan. Changes in city hall, from a progressive to a conservative government, defended Rovira's Plan. Economic agents, mainly landowners, added their voice, being afraid of the effects of the plan's proclaimed low density. Cerdà's proposal went forward with some changes (García Melero, 1998).

⁵ The framework for the philosophy of traditional Chinese medicine (TCM) is rooted in Huang Di NeiJing (Yellow Emperor's Inner Canon), which is based on the yin-yang theory.

3. MERIDIAN-COLLATERAL SYSTEM

3.1 Yin and Yang

In the case of human body, traditional Chinese medicine (TCM) views the relatively static parts as “Yin”[阴], and the relatively moving sections “Yang”[阳].⁶ TCM holds that when Yin and Yang are in balance, the human body is healthy, if unbalance, the body will fall ill.⁷ In common with the human body, a city also has a binary opposition between Yin and Yang, the balance of which determines a city’s physical state. Here Yin and Yang indicates a pair of interdependent concepts, rather than two single terms. What is of particular importance is their interdependent, contradictory and integrated relations.

3.2 Meridians

As a regulating system in the human organism, meridians act as channels for transporting Qi[气] and blood, which connect the internal organs and the external muscles, integrating the body’s various organs into an organic whole. The meridians of a human body come in two forms: Firstly, there are visible passages-channels for transporting Qi[气] and blood, which is a complex of nerves, muscles, blood, lymph and other systems; Secondly, meridians can also be regarded as invisible regulating systems which transport and control human body’s life information and materials, including the body’s transporting manner, moving process as well as its circulation laws. More specifically, stimulating the meridian of heart can cure angina pectoris and cardiovascular diseases as well as treat mental illnesses such as insomnia.⁸ The former type of meridians is a physical organ, while the latter refers to a center of controlling a person’s mental state.

Cerdá, with a clear understanding of modern industrial civilization⁹, thought that modern mechanical civilization is featured with a high-speed mobility and a wide range of communication and pointed out that public machinery transportation would play a vital role in future cities. It is this visionary view that has made his plan still applicable to modern city development 150 years later.

6 [太极动而生阳,静而生阴]“when moving, Taiqi (the origin of the world) gives rise to Yang, while it is static, Taiqi begets Yin”, Song ben zhouYi(Song’s Annotation on ZhouYi).

7 [“阴阳和平之人, 其阴阳之气和, 血脉调”]“The people of balances Yin and Yang type are characterized by harmony between Yin and Yang and harmonious condition of the blood vessels.”(Yellow Emperor’s Canon Of Medicine Spiritual Pivot, translated into English by Li Zhaoguo, Translated into Modern Chinese by Liu Xiru, 2008)

8 [少阴, 心脉也。心者, 五脏六腑之大主也, 精神之所舍也, 其脏坚固, 邪弗能容也。容之则心伤, 心伤则神去, 神去则死矣.] ie :“ The Hand-Shaoyin[少阴] is the Heart Channel. The Heart is the dominator of the Five Zang-Organs[五脏] and the Six Fu-Organs[六腑] and the residence of the Essence and the spirit. The heart is firm and cannot be invaded by Xie(Evil)[邪]. If entered, the heart will be damaged. If the heart is damaged, the Spirit will be lost. If the spirit is lost, it will lead to death.”In a way, similar to the western literature, heart-broken not only means pain in the organ but also hurt in mental and in spirit.

9 Barcelona gained a reputation around Europe in the nineteenth century as a result of its industrial and commercial strength. It’s important to point out that Barcelona headed the “industrial revolution” not only in Catalonia, but in the whole Spain.

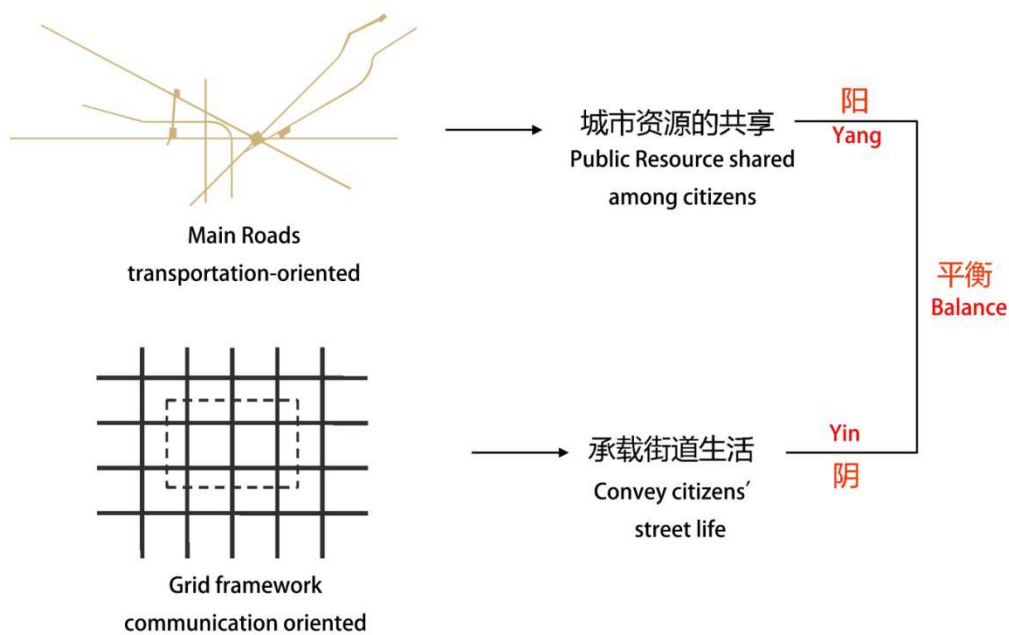


Fig4. Concept of Meridians in Cerdá's Eixample, which Pursue both values of equality and quality.

logistics and goods transportation, forming a smooth communication channel for the city's energy, information and resources. Even at that time there is only ENGINE ever heard but no trains or steamer he had ever seen, Cerdá foresaw the image for high-speed transportation inside a metropolis. The second level refers to the narrow and dense roads between "Manzana" blocks. These roads are 20 meters in width, the scale of which can offer the pedestrians a comfortable walking experience. Apart from some basic transportation functions, these roads provide a place for citizens' street life where they can stop and rest, stroll around, watch sceneries, cross streets and look back.

(3) Undifferentiated Blocks - Fair & Quality

In his plan, Cerdá designed geometry-shaped Manzana blocks and streets that can extend freely. In 19th century, the design of geometry-shaped street grids that can extend to any direction was a major innovation, the aim of which is not only to solve city problems, but more importantly, to free the urban and economic development from the restrictions of the plan as well, thus leading to a thriving urban development despite the shifting times. Indeed, a plan should be a necessary and effective tool in the long time. At the same time, the unlimited city development should allow people to develop freely and express themselves through an extended area.

The focal point of Cerdá's planning ideas is to achieve equality in people's living conditions, and the square is a "mathematical equality of the clearest and most authentic expression, this equality is equality of rights and interests, the fair itself." Thus, he designed the "checkerboard"

grid plane and created new districts outside the city walls in accordance with street grid and block patterns, covering 26k sqm of land outside the medieval Old Town with a homogeneous grid system. This kind of district which is 113 meters square is known as the "Manzana". However, it should be stressed that the grid pattern was not Cerdá's invention: it is the shape that he adopted as he considered the most efficient for structuring and giving cohesion to a city.

Considering the fact that the grid system may seem boring, wide streets are built in the diagonal direction, as a means of forming contact with the surrounding areas as well as making it possible to set up some unconventional construction in the angle of the intersection areas so that some landmark architectures can be located, which can then offer some unusual perspectives of the city.

In conclusion, in Cerdá's planning, the roads help form an intimate connection between nature and city, making the natural and the artificial balanced between Yin and Yang; In the north and south direction, the hills are directly connected to the Mediterranean, which facilitates urban drainage; The multiple-level roads coupled with grid-net blocks equip the city with the capacity to transport motor vehicles, ensuring the efficiency of urban development; Roads' sections are of appropriate scale with minute design of the details, offering an interesting walking experience to the pedestrians, which ensures urban life quality.

3.3 Acupuncture Points

Acupuncture points¹¹ are some special body places which can manifest how Qi[气] in the meridians diverges or converges. They can also be understood as sensors in the system of meridians. Then, what do the acupuncture points in Cerdá's planning refer to? Since acupuncture points are where Qi in the meridians diverges or converges, the city's acupuncture points should be places in which people, when taking part in social activities, diverge or converge. This part analyzes three elements of different levels as example of city acupuncture points, namely, city public greens, Manzana and public buildings.

(1) Urban Green Space

According to the new city blueprint, almost every city district divided by roads with a width of 35 or

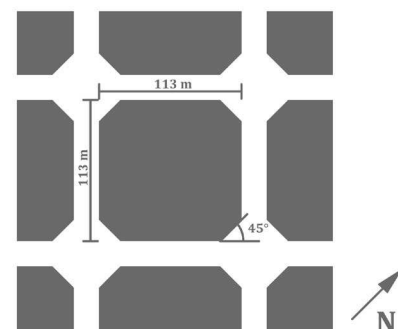


Fig5. Manzana, basic block.
(Source: Frank Kübler)

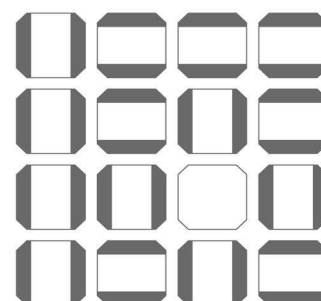


Fig6. Block organization
(Source: Frank Kübler)

¹¹ The concept of acupoints was described in detail in Huang Di Nei Jing (Yellow Emperor's Inner Canon). It mentioned "pain as the point" and vividly illustrated how to locate an acupoint.



Fig7. Urban Green Space in Exiampe



Fig8. Public buildings in Exiampe

50 meters has a public green space, which is often large in scope, some even covering several blocks. (See picture) We can draw circles with public space being the center, 400meters, the distance which people can cover on foot in a comfortable state, being the radius. From this picture, we can easily understand the logic behind Cerdá's organization of the city greens-the walking radiation circles of the public greens have almost covered the whole new city, attaining a Yin-Yang balance between the buildings and the greens. This design fully demonstrates Cerdá's dream of a balanced distribution of city's public resources as well as his humanistic ideals of treating the city residents in an equal manner.

(2) Manzana

In Cerdà's planning, every Manzana is not enclosed by four walls, but rather confined by two walls (like the shape of letter "L") or three walls (like the shape of letter "C"), forming good communication ties among the Manzanas, the streets and the neighborhood. Further, the density, height and depth of the architectures in the Manzanas are controlled, which ensures a comfortable environment in the house. The aim is to turn Manzanas into a space where family life and social life interact with each other and the residents can socialize with the neighbors, hence the term city's acupuncture points. This neat grid system is the most vivid and direct demonstration of Cerdà's idea that a city's resources should be evenly distributed.

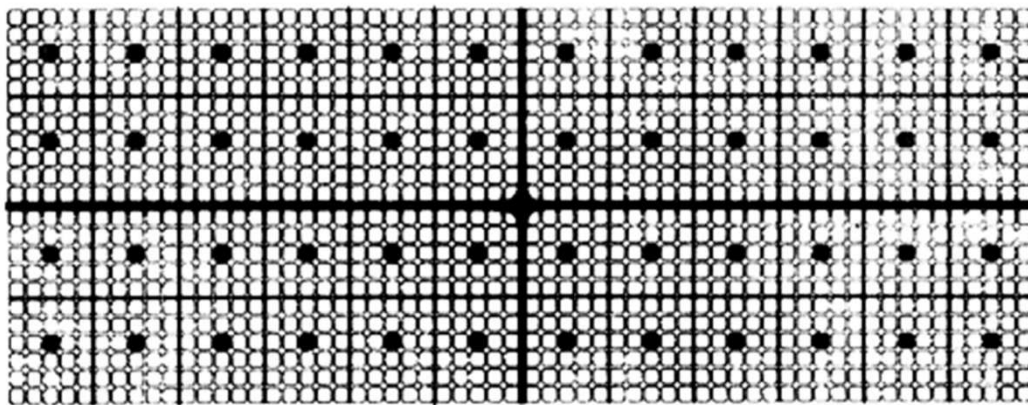


Fig9. Possible theoretical model applied by Cerdà to the "Ensanche of Barcelona". This square gridiron system of 60*22 blocks is grouped in smaller urban units in which center are located the public buildings), generating a homogeneous structure of communities and services for the entire city. (Source: *Laboratorio de Urbanismo de E.T.S.A.B.* 1978)

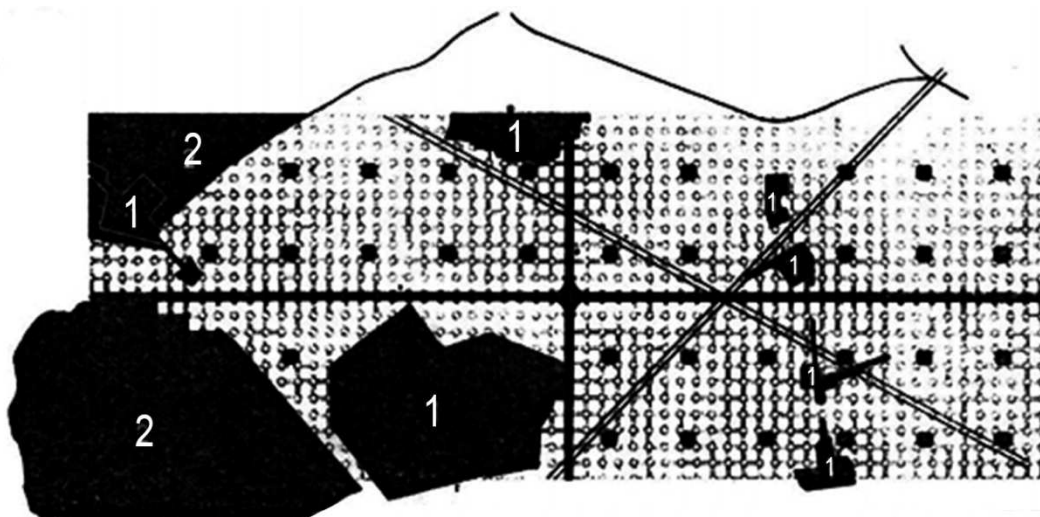


Fig10. Adaptation of the model to the existing conditions of Barcelona.

1. Old town and surrounding settlements.
2. Areas which topographic configuration did not adapt to the gridiron layout.

(Source: *Laboratorio de Urbanismo de E.T.S.A.B.* 1978)

(3) Public Buildings

To locate the public buildings, Cerdá designed a distribution model which is a system composed of 60*22 Manzanas. In this model, the city consists of sets of regular units, each unit being a community formed by five Manzanas, with the center of each unit locating the city's public service facilities, including church, school and other public buildings.

Being an ideal model, when the map was compared to Barcelona's original layout, some adjustments have to be made, including integrating the old city and surrounding villages as well as making room for the natural hills.

Taking all aspects into consideration, Cerdá finally decided on the layout of the public buildings in which the civil facilities were generally located at the center of the communities. If we again draw circles with the public buildings being the center, we can reach the same conclusion as that of the public greens, that is, Cerdá evenly distributed the city's public resources (see picture). In a word, Barcelona's public resources, be they public greens or public buildings, are all evenly distributed in the city space, satisfying the life needs of the citizens.

What is worth mention is that Cerdá designed graveyards on the left and right side as well as in the middle of the northern part of the new city. In this sense, Cerdá's idea that city resources should be evenly distributed was applied not only to people's houses in this world but also to their houses in the afterworld.

In sum Cerdá's planning, the units on every level, be they public greens, public buildings, the unit greens or the Manzanas, were all designed with an inner structure, with the public space at the center of the unit and its corresponding citizen's city life, community life, neighborhood life and family life surrounding this center, which forms an Yin-Yang relationship. However, it is the even distribution of the city units that has formed a balanced and multi-center city structure. Hence the city is in a state of balance, embodying the idea of binary opposition in every corner of the city.

4. DISCUSSION

To human body, under healthy mental and physiological conditions, Yin- Yang are in equilibrium, whereas under pathological conditions, yin and yang are in disequilibrium. Therefore, maintaining yin-yang balance by rebalancing deficiency or excess has become the main principle of TCM (traditional Chinese Medicine) clinical practices.

When it comes to city, the Meridian-collateral system theory still works. In terms of city, roads may represent the Meridians or Channels, and the public spaces may act as the Acupoints. However, what we emphasized here is not the corresponding one-for-one, for much more vital




ordenação	altura máxima	níveis	profundidade máxima	interior dos quarteirões	superfície edificável	seção
Cerdà	16m	térreo+3	26m	espaço livre para jardim	50%	
1860-1890	16m (depois 20m)	térreo+3 ou 4	26m	não se especifica	50% (depois 70%)	
1891-1941	20m (23m em 1932)	térreo+5	28m	4,4m (5,5m em 1932)	73%	
1942-1975	24,4m	térreo+5+ático+ sobre ático	28m	5,5m	73%	
1976	20,75m	térreo+5+ático	26m	4,5m. Estímulo a usos coletivos e verde	70%	
1986	20,75m	térreo+5+ático	26m	propostas de espaços públicos	70%	

Fig11 . Table1. The urban expansion development. (Source:IsabelaSolleroLemos, 2011)

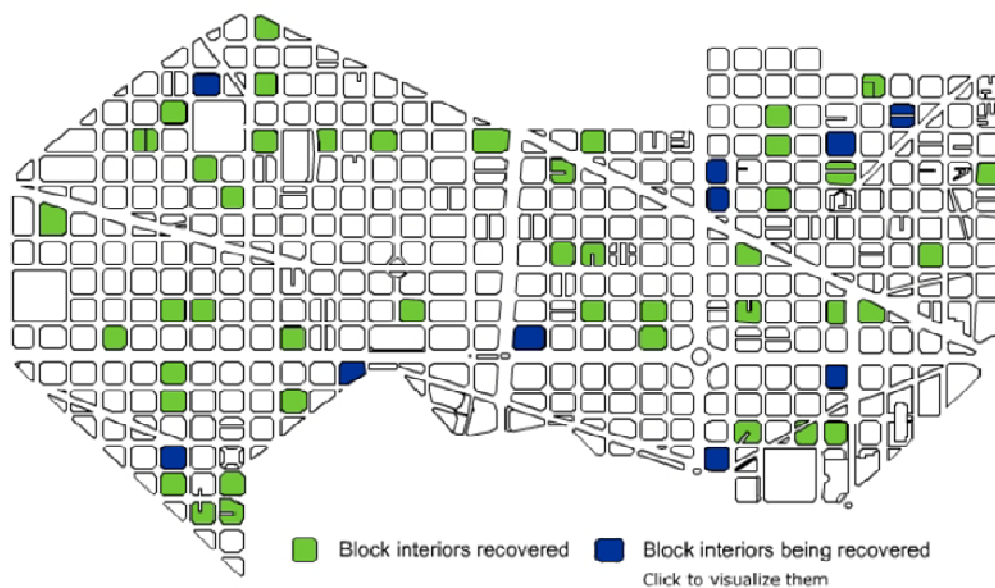


Fig12. Map of courtyards recovered hair ProEixample programme, 2009

(Source:www.proeixample.cat/1000/1400.html)

issue is their interdependent, contradictory and integrated relationship¹². More specifically, every city exists in the world for sure layouts its own roads and public places, but it is hard to say whether they work well or not.

Modern city is a complex system, including economic, policy, resources, culture and environment. In essence, the city is a comprehensive system of complex nature, and has a similar development and evolution rules with life. It has process of the natural evolution in time and space, such as growth, extinction and self-renewal. It also has self-adjustment and self reproduction. Every city may become ill inevitable from its origin. But the key question is how to treat disease indifferent times and situations.

¹² Same as the relationship emphasized for Yin-Yang.

Barcelona is such a right urban form-giver. The Meridian-collateral system structure is clear, crossing platform, and is easy to manage, whose good extensibility and maintainability can be guarantee. The renewal of Barcelona since the return of the democratic government can be a good example to support. ¹³(Fig11) Based on the belief of "pain as the point"¹⁴, inspire the location of an acupoint (ie public places in different scales) could be identified in accordance with the progression of a disease (city illness). The therapeutic function of an acupoint has also been extended from treating a limited body part to treating a comprehensive system corresponding to the symptoms of meridians and collaterals. (Fig12)

Cerdà cannot only be read and interpreted limited in historical perspective, but on the basis of the strength of his innovative ideas and proposals. (This is to say, thinking into the future). For an urban plan, the real and only criterion is whether it has the ability to adapt to the time change, rather than just the drawings or the shocking effect just when completed. The Eixample plan for Barcelona, which makes the city full of vitality for 150 years, is no doubt a successful one.

The main intent of this article and thinking is not focusing on the research of the connection between Cerdà and "Yi", but to illustrate that the key to making the city vibrant and timeless is the idea of balance, which can be found in Cerdà's Eixample plan for Barcelona and the humanistic care in his great spirit.

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¹³The PGM (Barcelona Metropolitan Plan, 1976) reduced the building density indices from 10 to 6 times those foreseen by Cerdà.

¹⁴[不通则痛]stagnation of Qi and blood may bring about pain.

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